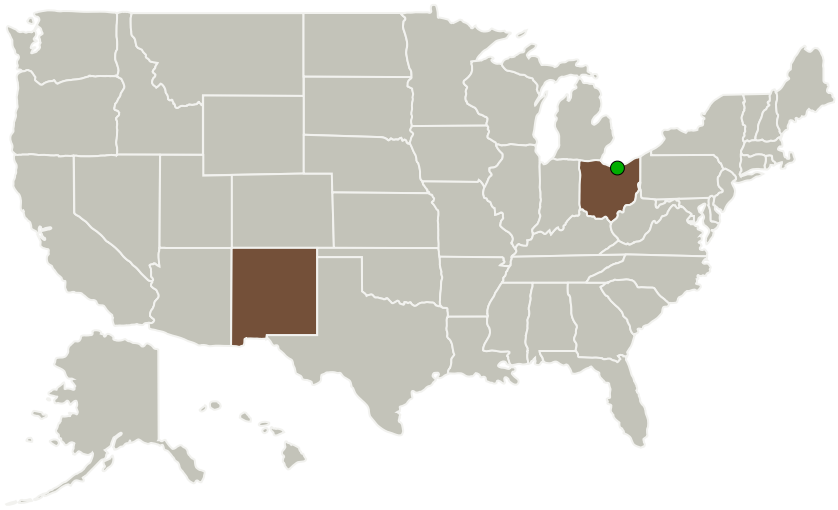
All-Solid, High-Performance Li-Ion Batteries for NASA's Future Science Missions, Phase I

Completed Technology Project (2014 - 2014)

Project Introduction

The state-of-the-art Li-ion battery technology is based on processing of lithium transition metal oxides, and graphite powder, and use of liquid organic electrolytes. It has shown limited room for further performance improvements in terms of energy density, cycle and calendar life, abuse tolerance and cost. This has heavily hindered the advancements of NASA's future space missions that need rechargeable batteries with higher energy density, longer life, and excellent abuse tolerance. In the commercial sector of electrical vehicles (EVs) and hybrid electric vehicles (HEVs), there are also urgent needs for rechargeable batteries with significantly higher performance characteristics that appear beyond the potential of current Li-ion system. TH Chem, Inc. (THC) proposes to team with New Mexico Institute of Mining and Technology (NMT) to develop a new, all-solid-state Li-ion technology for NASA's future space missions that require rechargeable batteries capable of higher energy density (>200 Wh/kg), longer cycle life (>50,000 cycles), extended operation temperatures and radiation tolerance. The new battery system is based on development of a novel, all-solid-state, 3-dimmensional (D) battery design that exploits the full potentials of the electrode and electrolyte materials. In Phase I, THC will demonstrate the feasibility of the new battery technology by preparation of the proposed all-solid-state 3-D batteries via processing of electrode and electrolyte precursors, followed by electrochemical evaluation of the test cells. The concept of the new electrochemical system will be demonstrated. THC and its team have extensive experience in advanced rechargeable battery chemistries and technologies.

Primary U.S. Work Locations and Key Partners



Battery Performance Characteristics Comparison

	Current Li-ion	*THC's All-Solid, 3-D Li-ion*
Energy Density (Wh/Kg)	~ 150	*~ 250*
Power Density (W/Kg)	Low	*Moderate*
Cycle Life	~ 1000	*~ 50,000*
Operation Temperature (°C)	-20 to +60	*-20 to +500*
Radiation Tolerance	No	*Yes*

All-Solid, High-Performance Li-ion Batteries for NASA's Future Science Missions Project Image

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Organizations Performing Work	Role	Type	Location
TH Chem, Inc.	Lead Organization	Industry Minority-Owned Business, Women-Owned Small Business (WOSB)	Albuquerque, New Mexico
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
New Mexico	Ohio

Project Transitions

June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137691)*

Images

BATTERY PERFORMANCE CHARACTERISTICS COMPARISON

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Project Image
All-Solid, High-Performance Li-ion Batteries for NASA's Future Science Missions Project Image *(https://techport.nasa.gov/image/134594)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
TH Chem, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

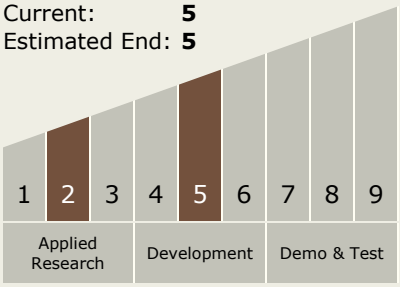
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Tc Chen

Technology Maturity (TRL)

Start: **2**
Current: **5**
Estimated End: **5**



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Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.2 Energy Storage
    - TX03.2.1 Electrochemical: Batteries

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System